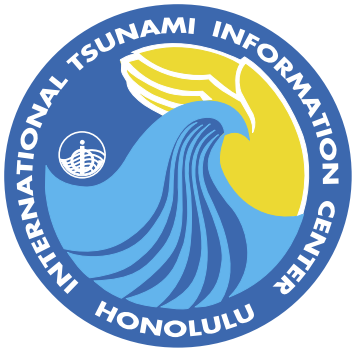
December 2002 Volume XXXIV, Number 6

Tsunami Newsletter



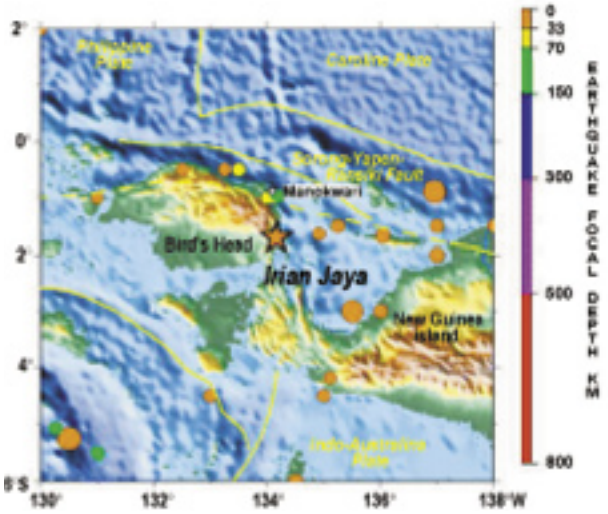
INTERNATIONAL TSUNAMI INFORMATION CENTER - ITIC

SUMMARY OF EARTHQUAKES IN THE PACIFIC
Occurring October-November 2002

With surface wave (M_S) or moment magnitudes (M_W) greater than or equal to 6.5 with a depth no greater than 100 km, or an event for which a Tsunami Information Bulletin (TIB) or Regional Watch Warning (RWW) was issued by the Richard H. Hagemeyer Pacific Tsunami Warning Center (PTWC). Epicenter from USGS/NEIC (G); preliminary M_S from PTWC (P) at time of action; and depth from Harvard (H)

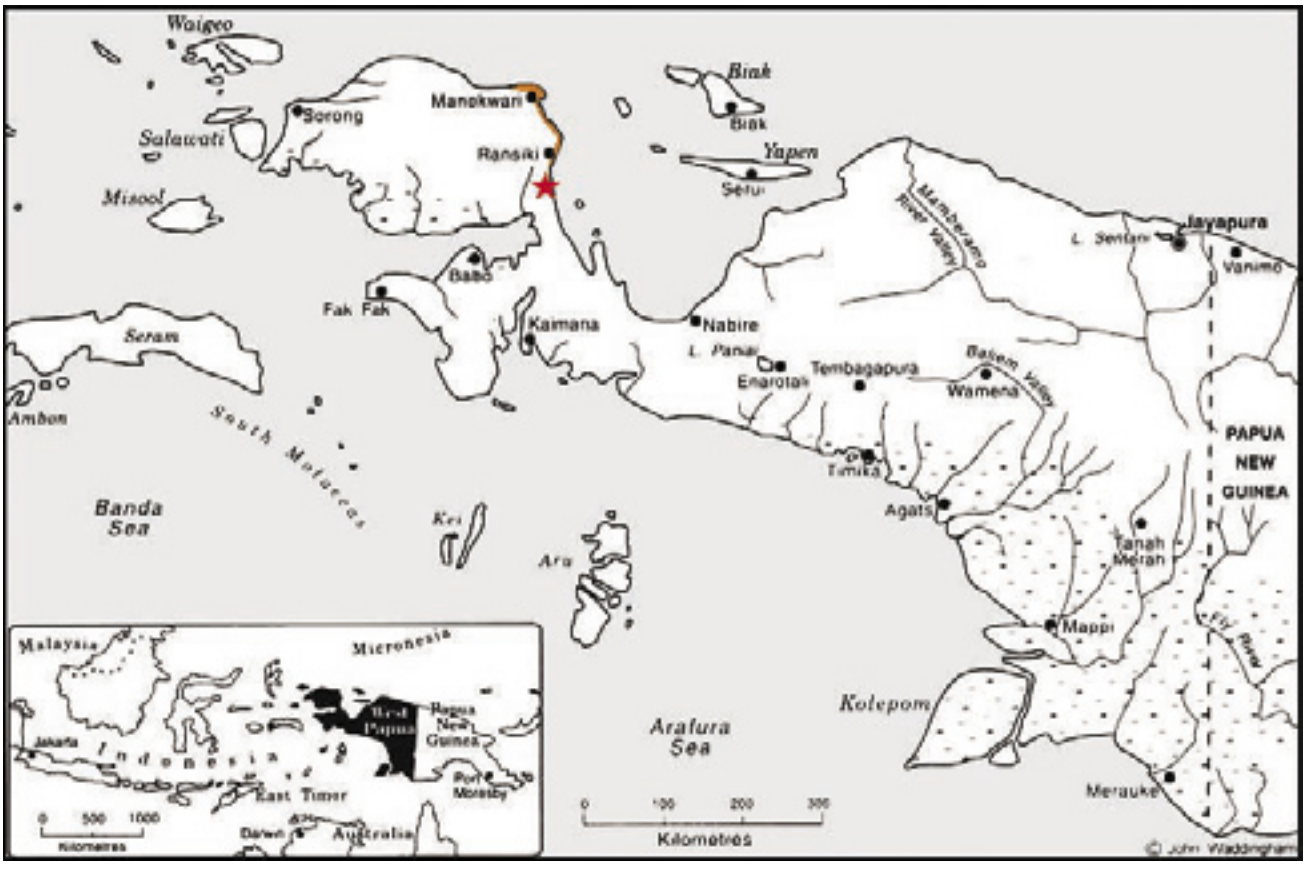
DATE	LOCATION	TIME (UTC)	LAT.	LONG.	DEPTH (km)	M_W	M_S	PTWC ACTION	ACTION (UTC)	Tsunami ?
Oct 10	Irian Jaya Region, Indonesia	10:50	1.684 S	134.149 E	15.0	7.6 (H)	7.5 (P) 7.8 (G)	TIB#1 TIB#2	11:24 11:32	?
Nov 2	Vicinity of Northern Sumatera, Indonesia	01:26	2.997 N	96.082 E	16.3	7.4 (G,H)	7.5 (P)	TIB	01:59	NO
Nov 3	Central Alaska	22:13	63.520 N	147.533W	18.8	7.9 (H)	7.5 (P) 8.0 (P)	TIB TIB	22:22 22:54	NO
Nov 7	Rat Islands, Aleutian Islands	15:14	51.172 N	179.459 E	28.8	6.6 (G.H)	7.0 (P) 6.4 (G)	TIB#2 TIB#3	15:58 15:31	NO

10 OCTOBER 2002 (10:50 GMT) 1.68 S 134.149 E IRIAN JAYA REGION



The map to the left shows the historical seismicity since 1900 in Irian Jaya Region (USGS National Earthquake Information Center). Plate boundaries are shown in yellow.

Harvard Centroid and USGS Rapid Moment Tensor solutions suggest strike-slip faulting associated with the northwest-striking Ransiki fault. In this tectonically complex area, oblique convergence occurring between the Indo-Australian Plate and the Caroline Plates is accommodated by crustal shortening and movement along the Sorong-Yapen-Ransiki fault. The fault runs from eastern New Guinea island through the Bird's Head at northwestern Irian Jaya west towards Halmahera.



The USGS National Earthquake Information Center reported in its description of the earthquake, that a 3-5 meter tsunami had been generated along the coastline between Manokwari and Ransiki, an area indicated in orange on the above map. (The star in the maps above indicate the epicenter of the earthquake).

In correspondence with Professor Lori Dengler, the BMG team (from Indonesia's National Seismological Center, Meteorological and Geophysical Agency) in Manokwari reported that they observed liquefaction along the coast of Manokwari, Oransbari, Ransiki and Panebuai along with subsidence of approximately 2-3m. in Oransbari. They observed one bridge in Oransbari coast that tilted and subsided about 2-3m. It was not clear whether subsidence resulted from tectonic processes or liquefaction. The team also observed tsunami of about 3-5m. in Oransbari and Ransiki and 1m. in Manokwari. The report of the team has not yet been received by ITIC and we have been unable to substantiate whether a formal followup report was completed.

GSN TELEMETRY AND THE PACIFIC TSUNAMI WARNING CENTER

Submitted by Rhett Butler, IRIS GSN Program Manager

The Global Seismographic Network(GSN) is a permanent network of state-of-the-art seismological and geophysical sensors connected by available telecommunications to serve the scientific research and monitoring requirements of our national and international community (Figure 1). All GSN data are freely and openly available to anyone via the Internet. Installed to provide broad, uniform global coverage of the Earth, 126 GSN stations are now sited from the South Pole to Siberia and from the Amazon basin to the seafloor of the Northeast Pacific Ocean, in cooperation with over 100 host organizations and seismic networks in 58 countries worldwide.

The GSN is a multi-use facility of the Incorporated Research Institutions for Seismology (IRIS), a not-for-profit consortium of 100 Universities in the United States. Funding for the GSN comes from the US National Science Foundation and the US Geological Survey (USGS). Operations and maintenance of the GSN are carried out by the USGS Albuquerque Seismological Laboratory (ASL) and the IRIS/IDA group at the University of California, San Diego.

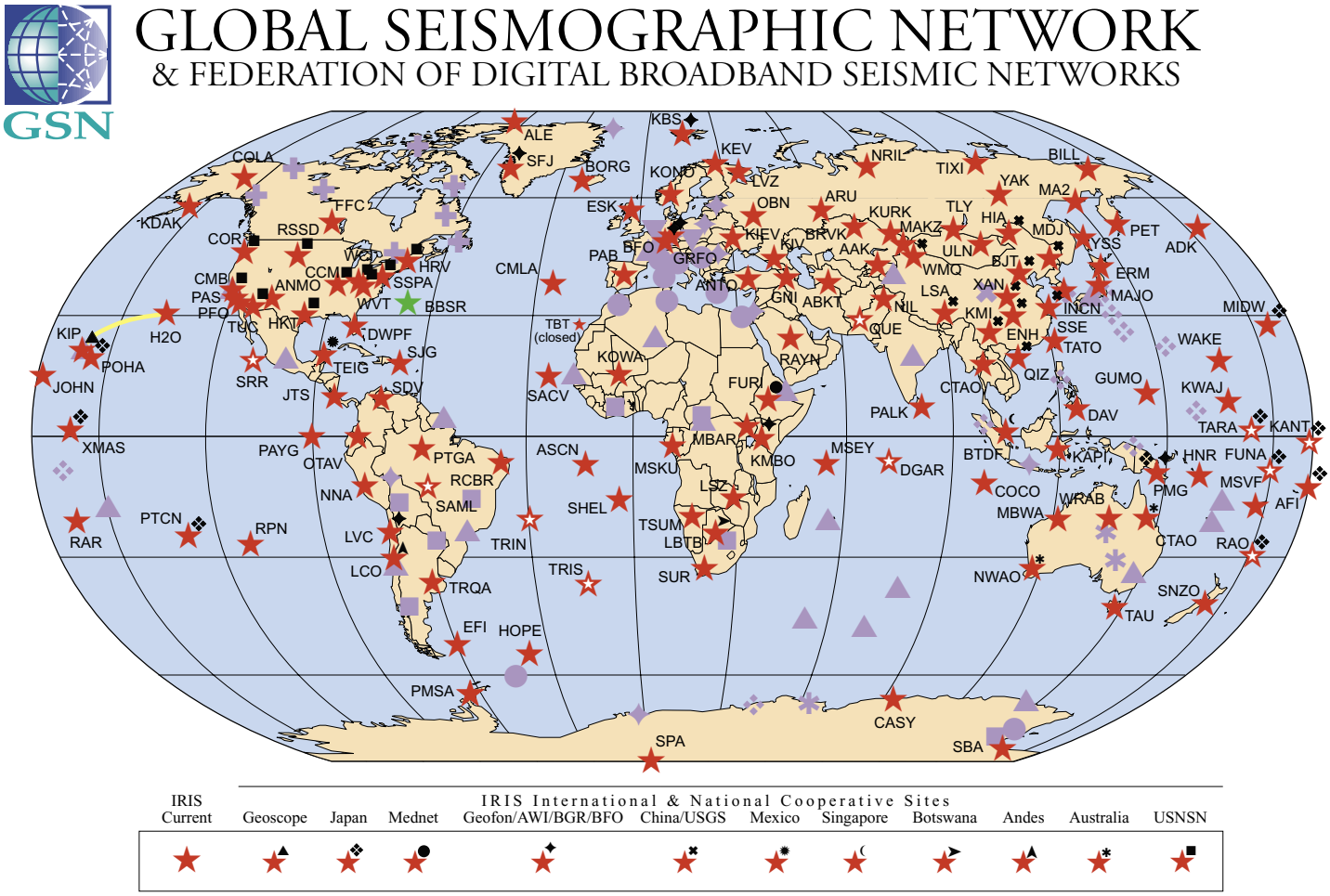


Figure 1. The map shows the current GSN stations (red stars), and planned sites (red-white stars) for completion in the coming years. FDSN Network stations are also shown (purple). Many GSN stations are cooperative with other national and international networks, indicated by the symbol on the 'shoulder' of the star. The newest GSN station in Bermuda is indicated by the green star.

GSN TELEMETRY AND PTWC, *continued*

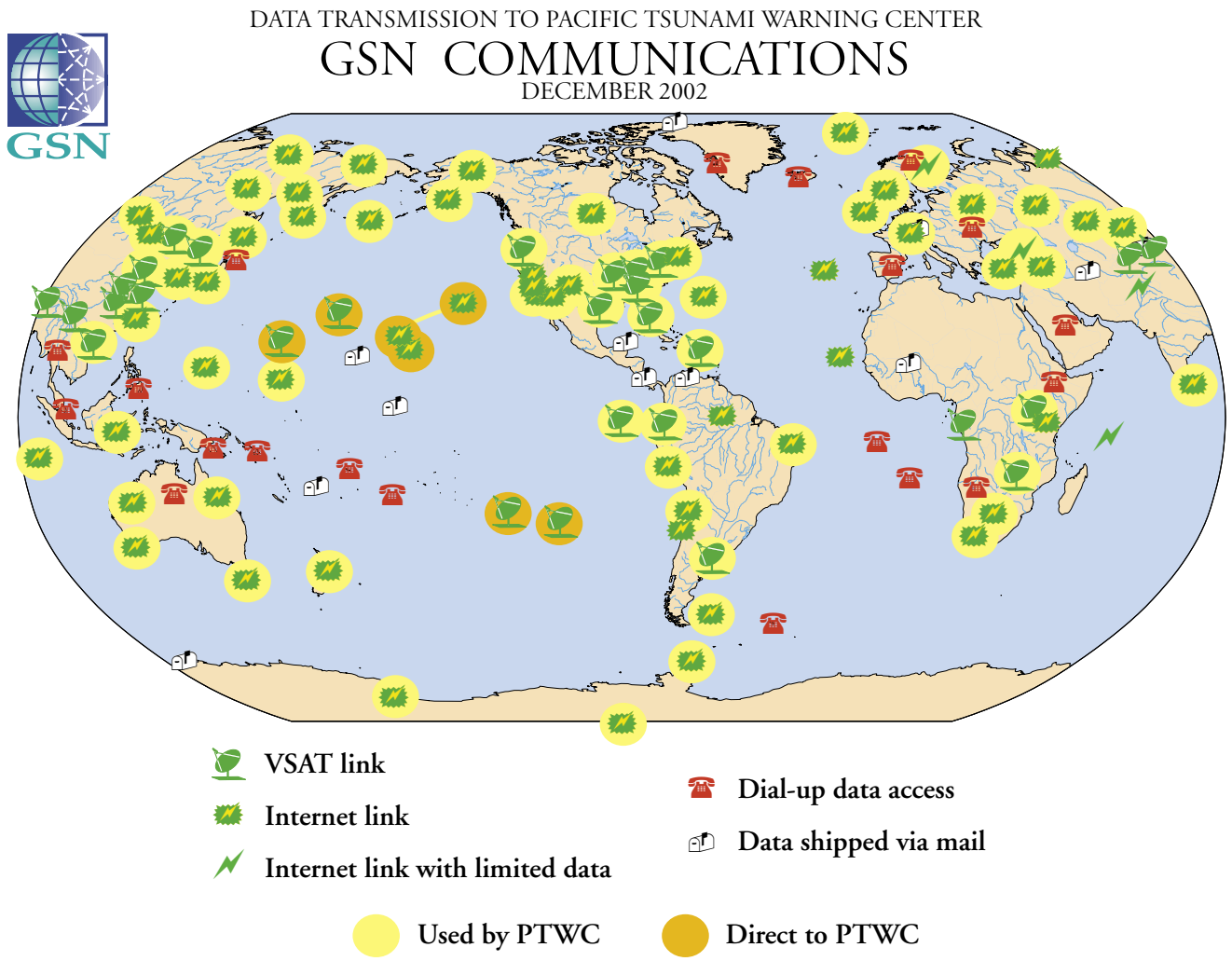


Figure 2. The map shows the current communications infrastructure to GSN stations worldwide. More than 75% of the Network has some form of real-time access, 15% have telephone dial-up access, and the remaining 10% rely upon mailed shipments of physical media. Sites highlighted in yellow are routinely used by the Pacific Tsunami Warning Center via Internet access. Sites highlighted in orange are used by PTWC via connectivity within Hawaii, or directly via the satellite.

The Global Seismographic Network plays an essential role for tsunami warning. Seismic signals from earthquakes propagate over 20 times faster than a tsunami travels, and thus serve not only to provide early warning and location, but also to characterize the tsunamigenic potential of the event. Large earthquakes are the greatest concern since the area of the fault and the displacement of the seafloor near the earthquake source relate to tsunami size. The long-period and high dynamic range instrumentation, which is standard for the GSN, is ideal for measuring the earthquake moment from seismic body waves and surface waves generated by such large earthquakes. Rapid access and analysisof the seismic data are essentialto enable a timely response to a tsunami threat.

GSN data is widely used by tsunami warning networks, and the GSN has worked closely with the National Weather Service (NWS) and the Richard H. Hagemeyer Pacific Tsunami Warning Center (PTWC) on Oahu to improve data access for monitoring. PTWC makes wide use of the real-time data from over 50 GSN sites to provide for broad, uniform global coverage, as shown in the telecommunications figure. Most of these links (highlighted in yellow in Figure 2) represent direct- access to GSN data servers at the ASL (via the Live Internet Seismic Server—LISS) from IRIS/IDA (via the Near Real Time System—NRTS), or indirect access to these same data through the USGS National Earthquake Information Center (NEIC) in Colorado (via Earthworm links with NEIC). However, in the rare

GSN TELEMETRY AND PTWC, *continued*

but important circumstance when circuit connectivity between Hawaii and the Mainland U.S. is disrupted, a subset of the GSN data adequate for teleseismic earthquake analysis still needs to get through to PTWC.

Direct connectivity of GSN stations to PTWC currently is available from a small subset of Pacific stations. In Hawaii, these include KIP, Kipapa, the local GSN station on Oahu which PTWC serves as host, and POHA, Pohakuloa, on the Big Island of Hawaii, for which GSN has arranged the routing of data to PTWC via inter-island circuits rather than through the Hawaiian Volcano Observatory link to California. Additionally, GSN data from the Hawaii-2 Observatory (H2O) on the seafloor between Hawaii and California comes to Oahu via the Hawaii-2 retired telephone cable, and is accessed directly from the University of Hawaii LISS server.

Figure 3. The IRIS GSN satellite hub is located at PTWC on Oahu.

Finally, to extend direct GSN connectivity to PTWC beyond the Hawaiian Islands, IRIS in cooperation with Japan and the US NOAA/National Weather Service (NWS), recently installed VSAT (Very Small Aperture Terminal) satellite communications at PTWC. The VSAT satellite technology enables end users, especially earth stations on remote Pacific islands, to transmit and receive data, voice, and video signals between it and a hub earth station utilizing a small earth station (usually less than 2.4 meters). End users are interconnected to each other through the hub station in a star topology, meaning that all communications are first transmitted from the end user via a satellite transponder in the sky to the hub before being retransmitted to another end user.

Figure 4. Pitcairn Islanders pose in front of the VSAT at the GSN station there, which is linked to PTWC.

From 1996 through 2001, IRIS and the National Research Institute for Earth Science and Disaster Prevention (NIED) of Japan entered into a cooperative plan to install joint GSN-NEID stations in the Pacific. During the final year of this cooperative plan, IRIS successfully proposed that NIED fund the GSN for a satellite master earth station hub for use by the joint GSN-NIED stations, and GSN approached NOAA/NWS, which operates the Tsunami Warning Centers, to install the hub at PTWC on Oahu. In exchange for direct data access by PTWC, NWS/NOAA agreed to pay the recurring satellite space segment costs, and to forward the GSN data from PTWC to the Internet. The PTWC hub and VSAT system was initiated in February, 2002, with a VSAT installation

GSN TELEMETRY AND PTWC, *continued*

on Pitcairn Island (Figures 3 and 4, respectively), and in subsequent months, VSATs were installed by GSN on Midway, Wake and Easter Islands. As shown in the Figure 2 (highlighted in orange), a total of four VSATs and three local internet connections now provide GSN data directly to PTWC. In 2003 GSN and PTWC plan to expand the VSAT coverage to additional GSN sites in Japan and islands in the central and south Pacific. In addition, the NWS is considering using the hub at PTWC to establish a direct connection between PTWC and the US West Coast/Alaska Tsunami Warning Center in Palmer, Alaska.

This is a classic example of synergy where cooperation has resulted in benefits for all. Working internationally with NIED of Japan, and nationally with the NWS/PTWC, the GSN has been able to build a satellite infrastructure with coverage of the entire Pacific region. PTWC is now able to directly received GSN data for real-time tsunami warning operations, and at the same time, these data have been made available to all via the Internet.

ITIC NEWS

Dr Slava Gusiakov visits SHOA (Chile)

After attending the VII International Earth Sciences Congress held 21-25 October 2002 in Santiago, Chile, Dr. Viascheslav Gusiakov (above right), Chairman of the IUGG Tsunami Commission, visited the Hydrographic and Oceanographic Service of the Chilean Navy (SHOA) in Valparaiso, Chile. During his visit, Dr. Gusiakov discussed tsunami issues with the ITIC Associate Director Rodrigo Nunez (above left), SHOA tsunami personnel, and Chile Regional HTDB Coordinator Emilio Lorca. Dr. Gusiakov presented Chile with the latest versions of the Integrated Tsunami Information System for the Pacific, the Expert Tsunami Data Base and the Historical Tsunami Database (HTDB) and Tsunami Travel Time (TTT) software, and provided a quick training session on its application and improvement of content.

On another project, Dr. Nunez gave Dr. Gusiakov the modified figures of the Tsunami and Earthquakes textbooks for inclusion in the Russian verion of the textbooks..

Visitors at ITIC

Drs. Boris Levin and Elena Sassorova of the P.P Shirshov Institute of Oceanology, Russian Academy of Science, Moscow, visited ITIC on December 12, 2002. During their visit, they discussed their recent research in which high-frequency, hydroacoustic signals from microearthquakes and seismic noise were observed as precursors to large oceanic Kuril-Kamchatka earthquakes. In their study, these signals were seen up to four hours before large earthquakes, and potentially could be useful for local tsunami warning. They discussed with ITIC Director Dr. Laura Kong possibilities for increased collaboration. In addition, Levin and Sassorova met with Linda Sjogren (below), ITIC's Information Specialist, to discuss some of the collection's Russian language materials.

MODELLING TSUNAMI HEIGHTS AND CURRENTS IN CANADIAN WEST COAST HARBOURS FROM CASCADIA MEGATHRUST EARTHQUAKE

Submitted by:
Fred Stephenson
Canadian Hydrographic Service, ITSU National Contact for Canada
and
Josef Cherniawsky
Institute of Ocean Sciences, Fisheries and Oceans Canada

A three year modelling study, funded by the Canadian Coast Guard's Search and Rescue (SAR) program, is being carried out to predict coastal sea level changes and currents in southern British Columbia harbours due to tsunami that may result from a megathrust earthquake in the Cascadia Subduction Zone. The last such earthquake occurred in 1700. From published modelling studies on tsunami propagation from Cascadia to Japan, and documented heights along a 900-km stretch of the Japan coast, the 1700 earthquake was estimated to have a moment magnitude of 9, centred on a 1000-km fault in Cascadia. These studies provide us with estimates of likely scenarios for plate motion at the tsunami source. Our initial experiments have used scenario 1A from Priest et al (2000).

The model used for this study is MOST (Titov and Synolakus, 1998), a shallow-water wave model used by NOAA to study tsunami effects along the west coast of Washington, Oregon and California, and in the inland waters

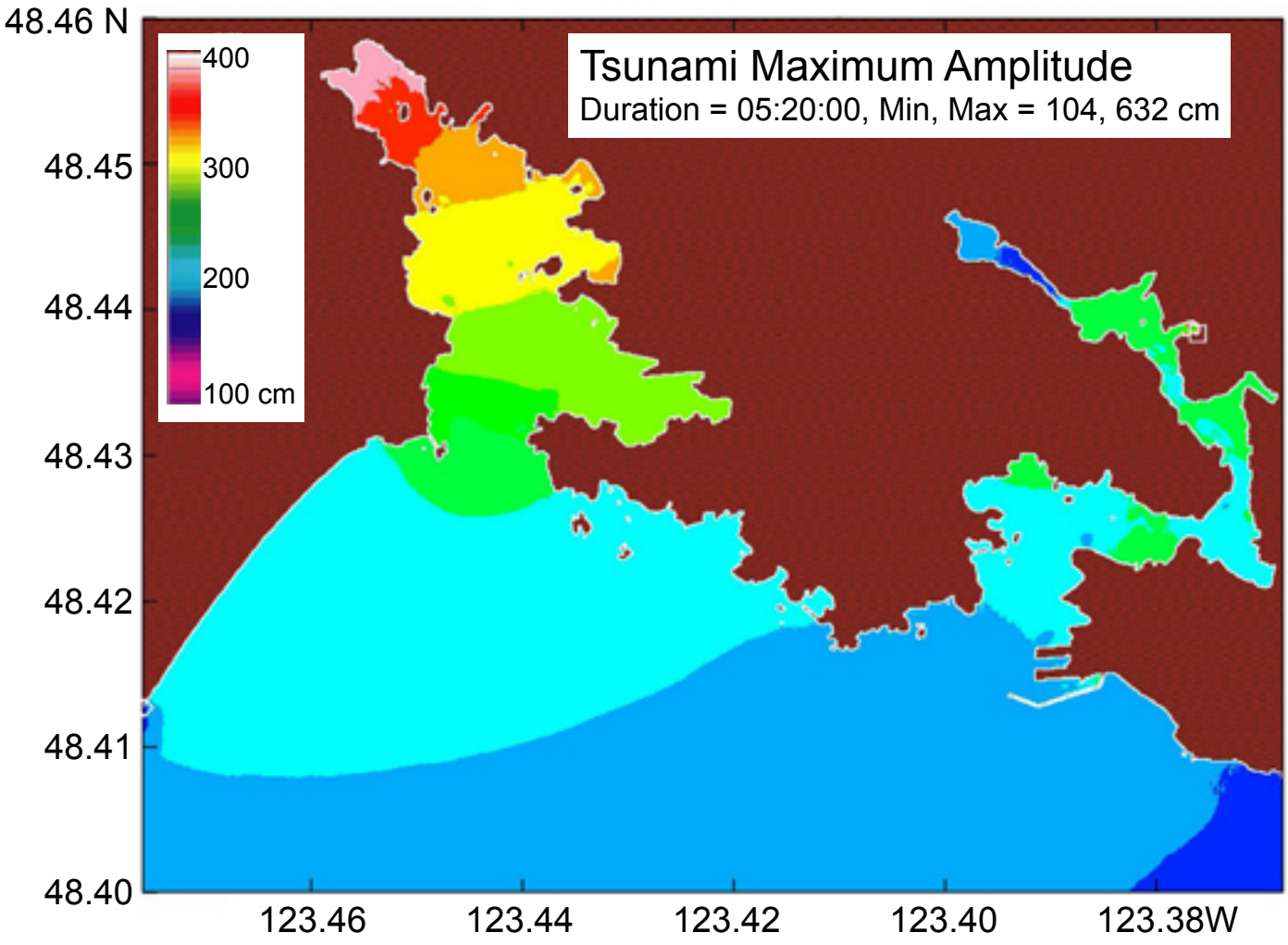


Figure 1 The maximum computed amplitudes during the first 6 hours of the model run. The model shows that maximum amplitudes outside the harbours in Juan de Fuca Strait are about 2 metres.

MODELLING TSUNAMI IN CANADIAN WEST COAST HARBOURS...., *continued*

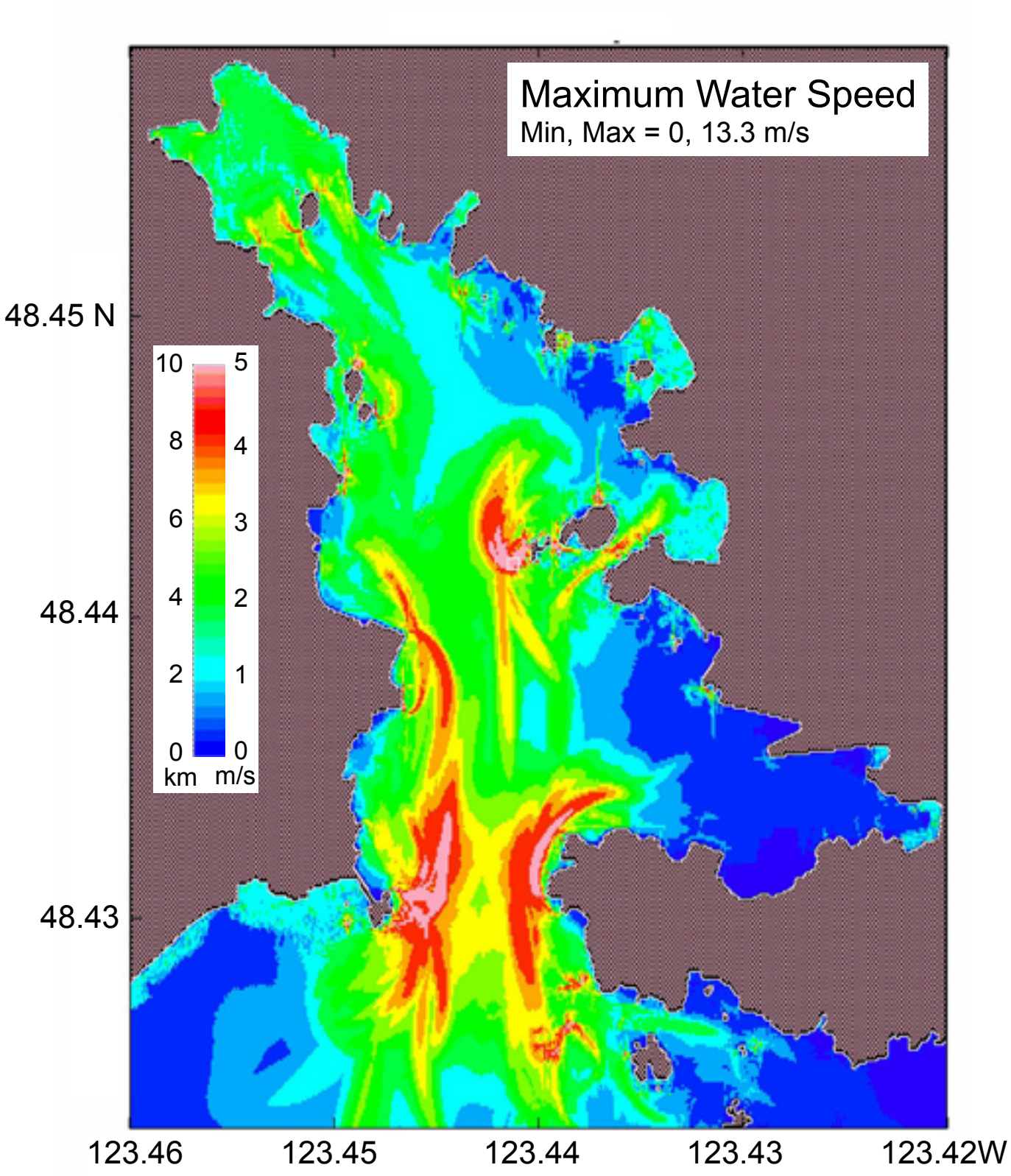


Figure 2 The maximum computed currents in Esquimalt Harbour during the first six hours of the model run.

MODELLING TSUNAMI IN CANADIAN WEST COAST HARBOURS....., *continued*

contiguous to Canada and the U.S. Adopting this model allows for data sharing (e.g. bathymetric data), and also produces results, which can be combined for studies of the entire Cascadia area.

The present modelling effort uses bathymetric grids up to several orders of magnitude finer than previous studies. The finer resolution gives more accurate results and allows us to see variations within harbours not possible with previous models. This will assist Coast Guard SAR in preparing emergency response plans for their facilities and for the local marine communities they serve. The study will model those harbours on the west coast of Vancouver Island most susceptible to tsunami originating in the Cascadia Subduction Zone. For most of these areas modern hydrographic surveys exist, but the survey data in many cases is not yet in digital format. The study is now in its second year and much of the effort to date has been directed at converting and validating this survey information.

Initial modelling efforts have been directed at harbours where digital data is already available. Fortunately, excellent multibeam coverage is available for both Victoria and Esquimalt Harbours on the south end of Vancouver Island. These harbours are located approximately 60 nautical miles from the mouth of Juan de Fuca Strait. Using these data sets it was possible to build a high-resolution (10-m grid), shallow-water equations model, linked to the source region with several lower-resolution nested grids.

Results of the first model runs have been extremely valuable and informative. Figure 1 shows the maximum computed amplitudes during the first 6 hours of the model run. The model shows that maximum amplitudes outside the harbours in Juan de Fuca Strait are about 2 metres. This is comparable with previous modelling studies using 2 km grids, where the computed maximum amplitudes were typically about 1.5 metres. In the harbours the response is quite different. The maximum amplitude in Victoria Harbour is about 3 metres, but in Esquimalt Harbour the maximum amplitude is nearly 5 metres. Maximum currents in both harbours are about 5 metres/sec (10 knots). Figure 2 shows the maximum computed currents in Esquimalt Harbour during the first 6 hours of the model run. A feature of this plot is that the high current areas are bi-directional showing both maximum incoming (flood) and outgoing (ebb) currents.

The data conversion required to produce digital copies of the hydrographic field sheets for the west coast of Vancouver Island is nearly complete. This information will be used to build the intermediate coastal grids (50-100 metre resolution) and the high-resolution grids (10-20 metre resolution) for the harbours and harbour approaches. If possible, high-resolution topographic data will also be collected in 2003 for at least one community using topographic LIDAR. The topographic grid produced using that data will be merged with the bathymetric grid to produce a seamless high-resolution grid so that the effects of inundation can be accurately modelled. The resulting model results will hopefully provide motivation for additional funding directed at the collection and integration of more topographic LIDAR data.

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UPCOMING CONFERENCES

April 6 - 11, 2003, (Sunday-Friday) "Tsunamis"at the **EGS-AGU-EUG Joint Assembly** to be held in Nice, France.

The aim of the symposium (NH6.01) is to consider the state-of-the-art research in regards to tsunami generation, propagation and impact along the coasts. There will be discussion of the tools to assess and mitigate tsunami hazard. The symposium is open to contributions from different disciplinary fields: geophysics, geology, numerical modelling, social and economical sciences, urban planning, warning and early-warning systems. All aspects of tsunami research theoretical, numerical, experimental and observational works (including remote sensing) are welcomed. Instructions for the preparation and submission of abstracts, as well as details regarding registration, accommodation, etc., are posted at the following website: http://www.copernicus.org/egsagueug/index.html.

The abstracts (in electronic form) should be sent directly to the EGS HQ and in copy to either convener listed on the next page before January 15, 2003.

UPCOMING CONFERENCES, *continued*

Convener:
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April 29-May 2 2003 (Wednesday-Friday) **Seismological Society of America Annual Meeting**, Caribe Hilton Hotel, San Juan, Puerto Rico. This meeting commemorates the 100th Anniversary of the University of Puerto Rico along with 100 years of seismic instrumentation in Puerto Rico. More can be learned about the conference by visiting the Web site: http://civil.uprm.edu/ssa-2003/. This year's meeting also includes a special technical session:

Seismological Tools for the Advancement of Tsunami Modeling and Warning. The convenors for this session are: Eric Geist (egeist@usgs.gov) and Aurelio Mercado (amercado@uprm.edu). The session is described as follows:

Advances in seismic instrumentation and source parameterization algorithms have had a significant impact on tsunami warning and hazard assessment capabilities. Improved accuracy of event location, focal depth, and magnitude information has had a direct effect on the accuracy of tsunami warning systems. The increase in the amount and availability of near-real time seismological information makes possible novel rapid tsunami models that can predict the severity and extent of a tsunami after an earthquake. In addition, the development of new earthquake hazard models can be used to forecast tsunami hazards from offshore fault zones. This session will cover a broad range of seismological applications toward the advancement of tsunami science, including emerging tsunami warning systems in the Caribbean and how seismological information can best be integrated with tsunami measurements and modeling.

Abstract submission deadline is January 24, 2003. Papers to be submitted by SSA members or sponsored by one.

May 5-7 2003 (Monday-Wednesday), Fiji (Outrigger Reef) **Public Safety and Risk Management Conference**. Sponsored by SOPAC (South Pacific Applied Geoscience Commission). The purpose of the conference is the promotion of disaster reduction policy/legislation development, research, training, scientific knowledge and technology transfer towards the reduction of community vulnerability from natural, environmental, technological and human induced disasters. For more information visit http://www.sopac.org.fj/Secretariat/Units/Dmu/Conference.html or contact: Vive Vuruyak; vive@sopac.org ; Tel: 679 338 1377.

June 29-July 2, (Sunday-Wednesday), **PACON 2003**, Hotel Splendor Kaohsiung, Kaohsiung, Taiwan. Ocean Capital Year, the Sixth Regional Symposium of the Pacific Congress on Marine Science and Technology (PACON). PACON is an international, non-profit professional marine science an technology society dedicated to the sharing of scientific and technical information among those interested in the future of the world's oceans with a Pacific focus. The theme of this year's meeting is Ocean Capital Year,, and technical sessions will revolve around 3 areas of concern: Ocean Science and Technology, Coastal Science and Technology, and Marine Resource Management. Deadline for abstracts is January 30, 2003. Details are available at http://www.hawaii.edu/PACON.

July 9-10 (Wednesday-Thursday) **JSS7 "Tsunamis: Their Science, Engineering and Hazard Mitigation"** IASPEI lead inter-association sponsored symposium as part of **IUGG 2003** (30 June-11 July) Sapporo, Japan. A field trip to Okushiri Island will follow the symposium on July 11-13. Deadline for abstract submission is January 30, 2003. Lead convener for this symposium is Viacheslav (Slava) Gusiakov (gvk@OMZG.SSCC.RU) and co-conveners are Kenji Satake and Efim Pelinovsky. For more about IUGG2003 visit: http://www.jamstec.go.jp/jamstec-e/iugg/index.html

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(Thanks to all who contributed copies!)

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Wishing you a joyous holiday season and a peaceful 2003

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Located in Honolulu, the International Tsunami Information Center (ITIC) was established on November 12, 1965 by the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO). In 1968, IOC formed an International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU).

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